3.1 PURPOSE

The flow-related fish enhancement measures described in this appendix were created to improve fish passage to the mainstem and tributaries near Bradbury Dam and provide additional rearing habitat in this area. Releases have been designed to provide continuous flows in Hilton Creek and the mainstem of the Santa Ynez River between the mouth of Hilton Creek and the Highway 154 Bridge in almost all years. Flow will also be maintained at Alisal Road in spill years and the year following a spill year. Releases may also be made into the Stilling Basin, likely to occur in wet years, to improve habitat in the short reach between the dam and the mouth of Hilton Creek. Finally, releases will be made into the mainstem to provide additional passage opportunities for migrating steelhead. This section describes how releases will be made to enhance the fishery in the lower Santa Ynez River.

3.2 LAKE CACHUMA SURCHARGE

The storage capacity in Lake Cachuma can be increased by installing higher flashboards on the spillway radial gates at Bradbury Dam that will allow surcharging of the reservoir. The additional water stored will support the flow-related enhancement measures. Currently, Reclamation can surcharge Lake Cachuma to 0.75 feet above the reservoir full level at elevation 750 feet. A 0.75 foot surcharge yields approximately 2,300 AF of additional storage in Lake Cachuma in years when the reservoir spills. About 5,500 AF of storage is provided by a 1.8 foot surcharge. A surcharge of 3 feet would provide conservation storage of about 9,200 AF over that available at the 750 foot elevation. Operations modeling for the 1918 to 1993 period of record indicates that the 3-foot surcharge, proposed here for long-term operations, would likely occur in 24 out of the 76 years (32% of years).

For the higher levels of surcharge to occur (1.8 and 3 feet), environmental review must be completed, flashboards for the existing spillway gates must be modified, and there must be an opportunity to surcharge the reservoir. Reclamation has already determined that it is feasible, from an engineering perspective, to make the appropriate spillway gate modifications for either the 1.8 or 3-foot surcharge (Reclamation 1998). Surcharging the reservoir to 1.8 feet was evaluated in the EIR/EIS for the Cachuma Reservoir Contract Renewal (Woodward-Clyde Consultants 1995) and determined to have no significant impact. Surcharging the reservoir to a level higher than 1.8 feet (*i.e.*, elevation 753 feet) will require disclosure of potential effects on the human environment, including temporary flooding of some county park facilities, and effects on sensitive resources such as oak trees (NEPA compliance). Evaluation of potential effects on the human environment, under NEPA, for the proposed 3-foot surcharge will be evaluated by Reclamation. CEQA review will be accomplished by the EIR currently in process by the SWRCB. It is anticipated that construction of the flashboard modifications required to allow

the 1.8 foot surcharge will be completed next year. These modified flashboards will also accommodate the 3 foot surcharge once environmental review is complete.

The long-term operations described below will begin once the reservoir has surcharged to the proposed 3-foot level for the first time, thus storing an additional 9,200 AF of water to support the actions. Reclamation has proposed operations changes to benefit steelhead and their habitat in the interim period prior to implementation of the proposed 3-foot surcharge. Reclamation anticipates that the environmental review and construction required to implement the proposed 3-foot surcharge will be in place by 2004 with the implementation of long-term operations expected in 2005, should sufficient rain occur to allow for surcharge in this year.

Sections 3.3 through 3.5 present the long-term releases proposed for fish enhancement (long-term operations). Section 3.6 presents those actions that will be taken in the interim prior to surcharging the reservoir to the 3-foot level required for implementation of the long-term operations. In addition to the flow-related enhancement measures, a number of conservation measures will be implemented as described in Appendices C and D, and a long-term monitoring program will also be included to assist in the adaptive management and evaluation of the program (Appendix I).

3.3 CONJUNCTIVE USE OF RESERVOIR RELEASES AND DOWNSTREAM WATER RIGHTS RELEASES TO MEET MAINSTEM REARING TARGET FLOWS

The objective of conjunctive operations is to extend the period of time each year when instream flows improve fisheries habitat for over-summering and juvenile rearing within the mainstem river and Hilton Creek. As a part of the Project operations, water will be made available within Lake Cachuma for the purpose of environmental protection and enhancement of habitat downstream of Bradbury Dam. Mainstem target flow levels have been designed to reflect annual and inter-annual variations in hydrologic conditions.

First priority for flow enhancement will be given to Hilton Creek and the reach from the Hilton Creek confluence to Highway 154. The second priority will be the area between Bradbury Dam and the Hilton Creek confluence, including the Stilling Basin and Long Pool, and third priority is given to the mainstem downstream from Highway 154 to the Solvang area. These priorities have been established based on the quality of existing habitat, the results of extensive water temperature monitoring and modeling, and the likelihood for successful protection and improvement of steelhead use. Temperature monitoring and modeling suggest that improved temperature conditions will not extend beyond the Highway 154 Bridge.

Target flows will be established in the mainstem and will vary in order to provide greater biological benefit. In years of higher flow, the mouth of the estuary will open, and steelhead will be able to migrate up the mainstem to spawn. Under the proposed target flows, more water is provided in these years which are expected to be highly productive. In years of lower flow, the mouth may not open, and migration up the mainstem may not be possible; but fish holding over from previous years must be sustained. Lower target flows are set to provide habitat

maintenance flows for these rearing fish. By having a variable mainstem target flow, more water is available when it will support the most steelhead.

During winter runoff seasons, natural flow from tributaries generally provides instream flow in the mainstem of the Santa Ynez River. In wet years, instream flows continue into early summer. In addition, spills from Lake Cachuma tend to enhance and prolong the instream flows in the mainstem in wet years. Water rights releases are made during the spring, summer, and/or fall of most average and dry years. Additional reservoir releases will augment natural flow and water rights releases to meet rearing target flows that have been set at two locations in the mainstem. Releases to meet the target flows will be managed to extend the period of time when instream flows improve fisheries habitat for oversummering and juvenile rearing. Targets will be set at the Highway 154 Bridge in all but the driest of years and at the Alisal Road Bridge in spill years and the year following a spill year.

In general, managed releases provide opportunities for improved maintenance of fisheries habitat over longer periods of time than have occurred in the past several decades. These releases can be made from the Bradbury Dam outlet and/or via the Hilton Creek supplemental water supply facility. Benefits can include an increased amount of aquatic habitat, improved dissolved oxygen conditions from flushing of accumulated algae, and generally reduced water temperatures in habitat close to Bradbury Dam. Conjunctive operation of reservoir releases and water rights releases to meet mainstem rearing target flows will be made to improve habitat conditions *year-round* in all but the driest (2%) of years. The releases will build the rainbow trout/steelhead population during wet years, while maintaining the rainbow trout/steelhead population and other fishery resources in dry years.

3.3.1 DOWNSTREAM WATER RIGHTS RELEASES

Releases are made from Bradbury Dam to meet downstream water rights requirements (WR 89-18). These releases are typically made during the late spring and/or summer and early fall, using flow patterns designed to recharge the groundwater basin between Bradbury Dam and the Lompoc Narrows and the Lompoc groundwater basin. Mainstem rearing flow targets will be met and surpassed during water rights releases. The majority of the flow will be released through the Bradbury Dam outlet works, although a small portion may go via the Hilton Creek system. The conjunctive operation will occur through coordination among Reclamation, the Adaptive Management Committee, and Santa Ynez River Water Conservation District (SYRWCD), which has committed to participate in conjunctive use operations.

3.3.1.1 Water Rights Releases

SWRCB Order WR 73-37, as amended in Order WR 89-18, established requirements for the release of water from Lake Cachuma intended to offset the impacts of the Cachuma Project upon downstream water right holders. These releases from Lake Cachuma are structured on two water storage accounts in Lake Cachuma, one for the area above the Lompoc Narrows (Above Narrows, ANA) and one for the area below the Narrows (BNA).

The credits to the two accounts are determined based on the impairment in the amount of natural replenishment from the Santa Ynez River to the groundwater basins downstream of Bradbury Dam caused by the operation of Lake Cachuma. The ANA credits are calculated based on surface water observations and groundwater depletion in the above Narrows basin. The BNA credits are calculated based on constructive flows at the Narrows and constructive percolation from the Santa Ynez River in the Lompoc basin.

The amendments to WR 73-37, as ordered under WR 89-18, significantly increased the below Narrows releases for the Lompoc area, resulting in an operation benefiting both the above and below Narrows areas. Therefore, historical releases under WR 73-37 cannot represent the present release regime under WR 89-18. Table 3-1 and Table 3-2 show the historic releases at Bradbury Dam for the above and below Narrows areas under WR 73-37 and WR 89-18, respectively.

Downstream releases are typically not made in wet years because the groundwater basins are replenished by precipitation and runoff in the Santa Ynez River. In dry years, there are generally two or three periods of releases to provide water to the users in the above Narrows area. In normal years and in some dry years, depending on hydrologic conditions and availability of water in the ANA and BNA, combined releases are made to replenish the groundwater basins in the above and below Narrows areas. Downstream water rights releases are made when the Santa Ynez River bed is dry and water levels in the groundwater basins have receded so that there is at least 10,000 AF of dewatered storage available in the above Narrows basin. The duration and rate (including initial rate) of releases varies depending on whether water is released for the purpose of recharging only the above Narrows area or both the above and below Narrows areas together. For example, combined releases for the above and below Narrows areas may begin at the rate of 135 cfs to 150 cfs and are maintained at a steady rate for about 12 to 15 days before they are gradually decreased to lower flow rates. During the initial period of 12 to 15 days, the flow moves at a rate of less than 3 miles per day. As the recharge rate decreases in the river bed, the release rate is also gradually reduced depending on groundwater levels. In essence, the release rates are maintained at such rates that water would disappear in the lower reaches of the Santa Ynez River channel. Thus, water rights releases do not create a continuous channel to the ocean nor are releases made when continuous flow exists. The reduced releases could extend two to three months and then are gradually ramped down to match scheduled releases to meet mainstem target flows.

Table 3-1 Downstream Water Rights Releases[1] under WR 73-37 by Calendar Year

Calendar Year	ANA Release	BNA Release	Total Release
1974	1,353	0	1,353
1975	1,152	0	1,152
1976	4,237	0	4,237
1977	2,299	0	2,299
1978	56	0	56
1979	1,200	0	1,200
1980	0	0	0
1981	4,175	0	4,175
1982	6,655	755	7,410
1983	0	0	0
1984	3,162	0	3,162
1985	5,686	0	5,686
1986	5,317	1,780	7,097
1987	3,887	0	3,887
1988	5,050	1,283	6,333

[1](Acre Feet)

Table 3-2 Downstream Water Rights Releases[1] under WR 89-18 by Calendar Year

Calendar Year	ANA Release	BNA Release	Total Release
1989	5,192	0	5,192
1990	4,792	0	4,792
1991	7,745	3,638	11,383
1992	4,930	3,287	8,217
1993	0	0	0
1994	6,727	4,012	10,739
1995	0	0	0
1996	7,319	3,459	10,778
1997	9,522	3,438	12,960
1998	0	0	0
1999	0	0	0

[1] (Acre Feet)

Releases for the above Narrows areas are made for shorter durations and lower initial rates compared to the combined releases described above, but they follow the same principles.

3.3.1.2 CCWA Deliveries and Releases

In 1997, deliveries of water from the State Water Project (SWP) were started to the Santa Ynez River Water Conservation District, Improvement District Number 1 (ID #1) and Lake Cachuma. As part of the project, the pipeline that formerly delivered the Cachuma Project entitlement to ID #1 was purchased and improved by the Central Coast Water Authority (CCWA) to convey SWP water in through the outlet works in the dam and into the reservoir. This water is available for later conveyance to the South Coast. ID #1 will receive treated SWP water in exchange for ID #1's Cachuma Project entitlement.

The CCWA pumping facility has a maximum capacity of 22 cfs. When a downstream release coincides with a SWP water delivery, and the releases is greater than the 10 cfs design capacity of the Hilton Creek system, SWP water will be blended in the outlet works with Lake Cachuma water and released to the river. For fisheries purposes, CCWA has agreed to guarantee a released water temperature of less than 18°C when SWP water is to be released into the river downstream of the dam. In addition, the SWP water will not comprise more than half of the water to be released into the river. CCWA water will not be released into the Santa Ynez River when there is continuous flow from the dam to the ocean during the months of December through June (NMFS 2000). This provision will prevent smolts that could migrate to the ocean from potentially imprinting on non-Santa Ynez River basin water. Because downstream water rights releases are made only when there is discontinuous flow in the Santa Ynez River mainstem, the provision will have no impact on water rights releases.

3.3.1.3 Mainstem Ramping

Operation of water rights releases will be managed to avoid stranding of rainbow trout/steelhead and other fish species. Since 1994, water rights releases have been ramped down voluntarily at the termination of the WR 89-18 releases in accordance with recommendations of the Biological Subcommittee of the SYRTAC. This practice will be continued under the proposed operations using the ramping schedule outlined in Table 3-3. A schedule for ramping flows upward is unnecessary as the travel time of water in the river will attenuate the rate of increase as described above.

3.3.2 MAINSTEM REARING TARGET FLOWS

Target flows for rainbow trout/steelhead rearing and over-summering will be established at two locations: at the Highway 154 Bridge and at the Alisal Bridge (Figure 2-1). Releases up to the system capacity (designed for 10 cfs) will be made from the Hilton Creek supplemental watering system to meet these targets. The supplemental system has the ability to make these

Table 3-3 Mainstem Ramping Schedule for Downstream Water Rights Releases

Release Rate (cfs)	Maximum Ramping Increment (cfs)	Minimum Ramping Frequency
> 90	25	4 hours
90 to 30	10	4 hours
30 to 10	5	4 hours
10 to 5	2.5	4 hours
5 to 3.5	1.5	4 hours
3.5 to 2.5	1	4 hours

releases to both Hilton Creek and/or the Stilling Basin based upon the criteria described in the Hilton Creek Appendix (Appendix D). In years when the lake spills (when the storage in Lake Cachuma is above 120,000 AF) and the spill amount exceeds 20,000 AF, a target flow of 10 cfs at the Highway 154 Bridge will be set. When the lake does not spill, or the spill amount is less than 20,000 AF, and the storage in Lake Cachuma exceeds 120,000 AF, then a target flow of 5 cfs will be maintained. When lake storage recedes below 120,000 AF, the target flow at the Highway 154 Bridge will be 2.5 cfs. When reservoir storage determines the target flow, storage will be assessed at the beginning of each month and the target flow set accordingly. In critical drought years (Lake Cachuma storage ≤30,000 AF), periodic releases from Bradbury Dam will be made to improve water quality in the Stilling Basin and the Long Pool. Thirty AF per month will be reserved to provide refreshing flows. In these years, Reclamation will consult with NMFS to determine what actions will be taken to protect steelhead in lower Hilton Creek and the mainstem reaches (NMFS 2000). These flow targets are summarized in Table 3-4.

In addition to the Highway 154 Bridge targets, flow targets will be established at the Alisal Bridge. In years when the Lake Cachuma spill amount exceeds 20,000 AF and steelhead are present in the Alisal Reach, a target flow of 1.5 cfs will be maintained at the Alisal Bridge. A 1.5 cfs target will also be maintained at this location in the year immediately following a spill year (a year with the spill amount exceeding 20,000 AF) if steelhead are present in the Alisal Reach.

Figure 3-1 shows what the annual releases would have been to meet the established mainstem target flows based on Santa Ynez River model runs from 1918 to 1993. The model analysis shows that the average release for habitat maintenance would have been approximately 2,290 AF under the proposed operations.

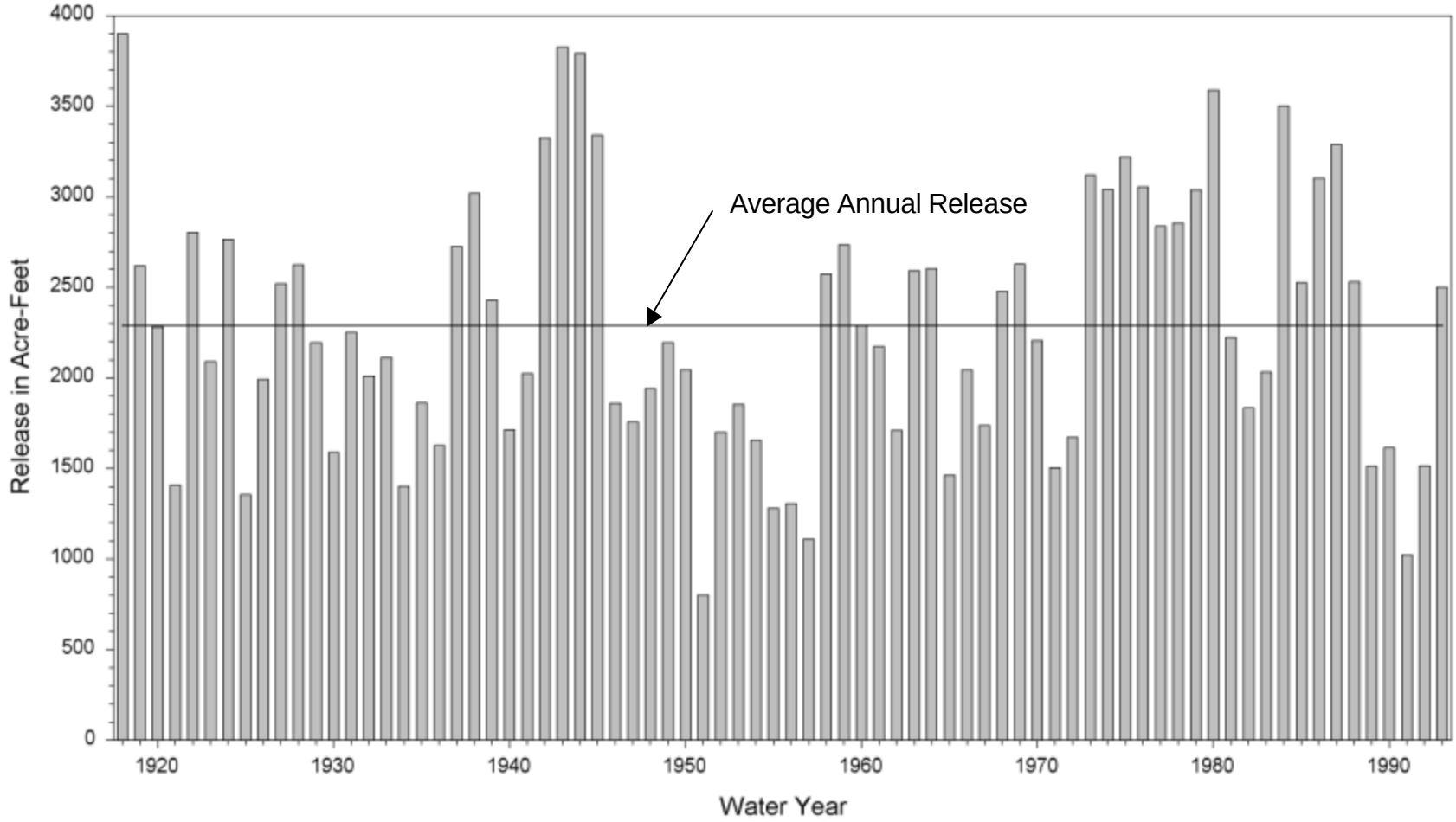

Figure 3-1 Modeled Annual Releases to Meet Long-Term Mainstem Rearing Target Flows

Table 3-4 Summary of Mainstem Target Flow Releases

Lake Cachuma Storage	Reservoir Spill?	Target Flow	Target Site
> 120,000 AF	Spill > 20,000 AF	10 cfs	Highway 154 Bridge
> 120,000 AF	Spill > 20,000 AF	1.5 cfs*	Alisal Road Bridge
> 120,000 AF	Spill < 20,000 AF or No Spill	5 cfs	Highway 154 Bridge
< 120,000 AF	No Spill	2.5 cfs	Highway 154 Bridge
< 30,000 AF	No Spill	Periodic release; ≤ 30 AF per month	Stilling Basin and Long Pool
> 30,000 AF	Spill < 20,000 AF or No Spill	1.5 cfs*	Alisal Road Bridge**

*When rainbow trout/steelhead are present in the Alisal Reach.
**This target will be met only in the year following a >20,000 AF spill year.

The target flows design provides for rearing flows at the Highway 154 Bridge in all but the driest 2% of years. In these dry years, mainstem habitat will be refreshed instead of a continual flow target being met. Analysis of historical hydrology using the Santa Ynez River Hydrological Model (SYRHM) monthly data indicates that it will be possible to meet the target flows under most conditions. Figure 3-2 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the SYRHM from 1918 to 1993. Flow at Highway 154 would exceed 2.5 cfs about 98% of the time, 5 cfs about 77% of the time, and 10 cfs about 39% of the time. Some of the flow targeted for Highway 154 persists downstream as far as the Alisal Reach during most years (Figure 3-3). Flow at the Alisal Bridge, according to the model, would exceed 1.5 cfs approximately 75% of the time.

In order not to impact State Water Project deliveries, the Hilton Creek supplemental watering system will be used to make the reservoir releases necessary to meet the mainstem rearing target flows. Based on the designed capacity of the Hilton Creek supplemental watering system to deliver 10 cfs, the model shows that the 10 cfs target at Highway 154 was not met in its entirety in 34 out of the 185 months that the 10 cfs target would have been in place. However, the model demonstrates that in those months where the 10 cfs target was not met, there would have been at least 8.5 cfs at Highway 154. The model showed that the other targets would have been met in all years based on historical watershed conditions. The existing infrastructure of the Hilton Creek facility (the gravity fed portion of the system) is being repaired to increase the capacity which is currently below the anticipated 10 cfs level. Additional portions of the facility, the pump and flexible intake, will be added in the next few years.

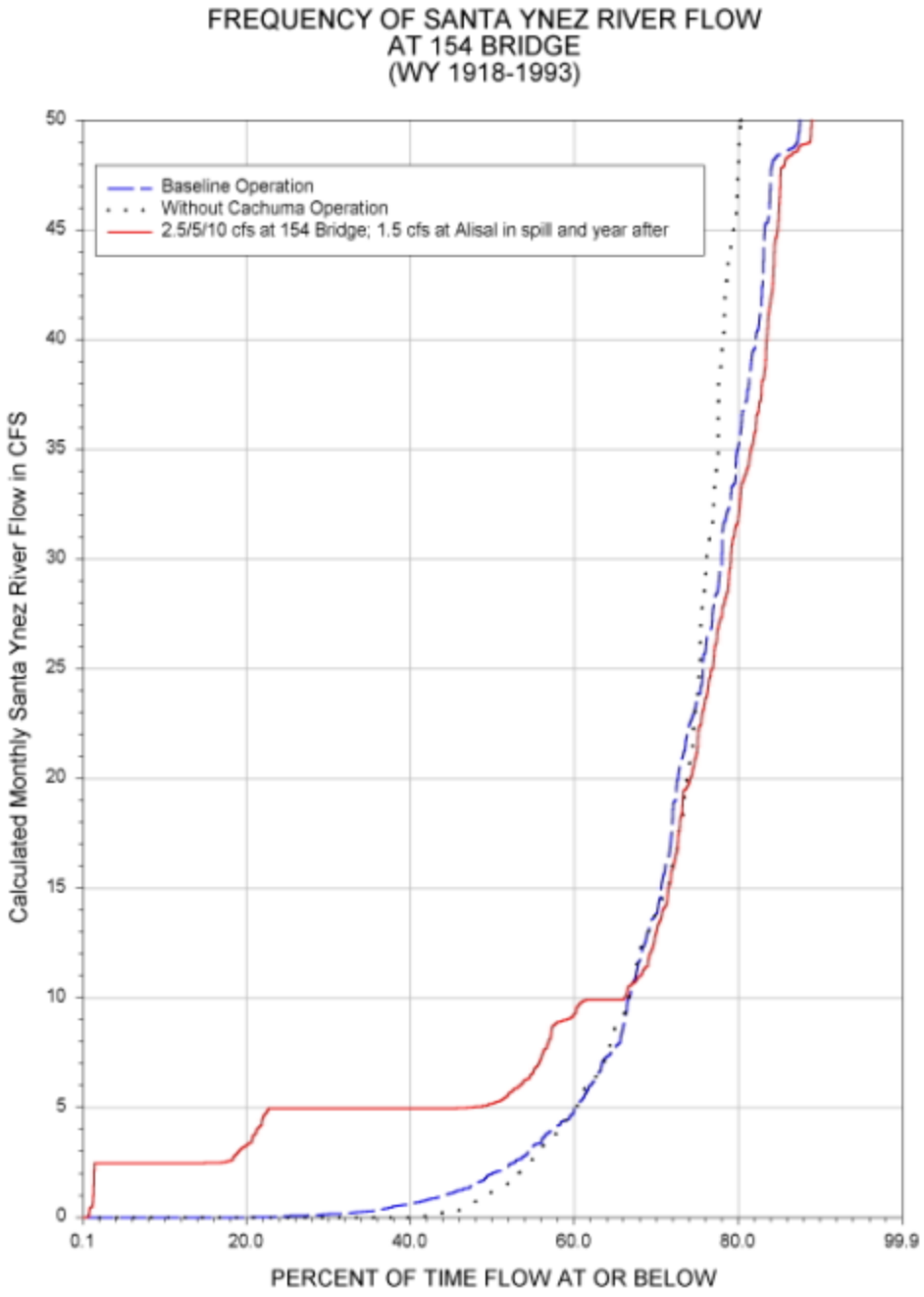

Figure 3-2 Modeled Flow at the Highway 154 Bridge under Long-Term Operations

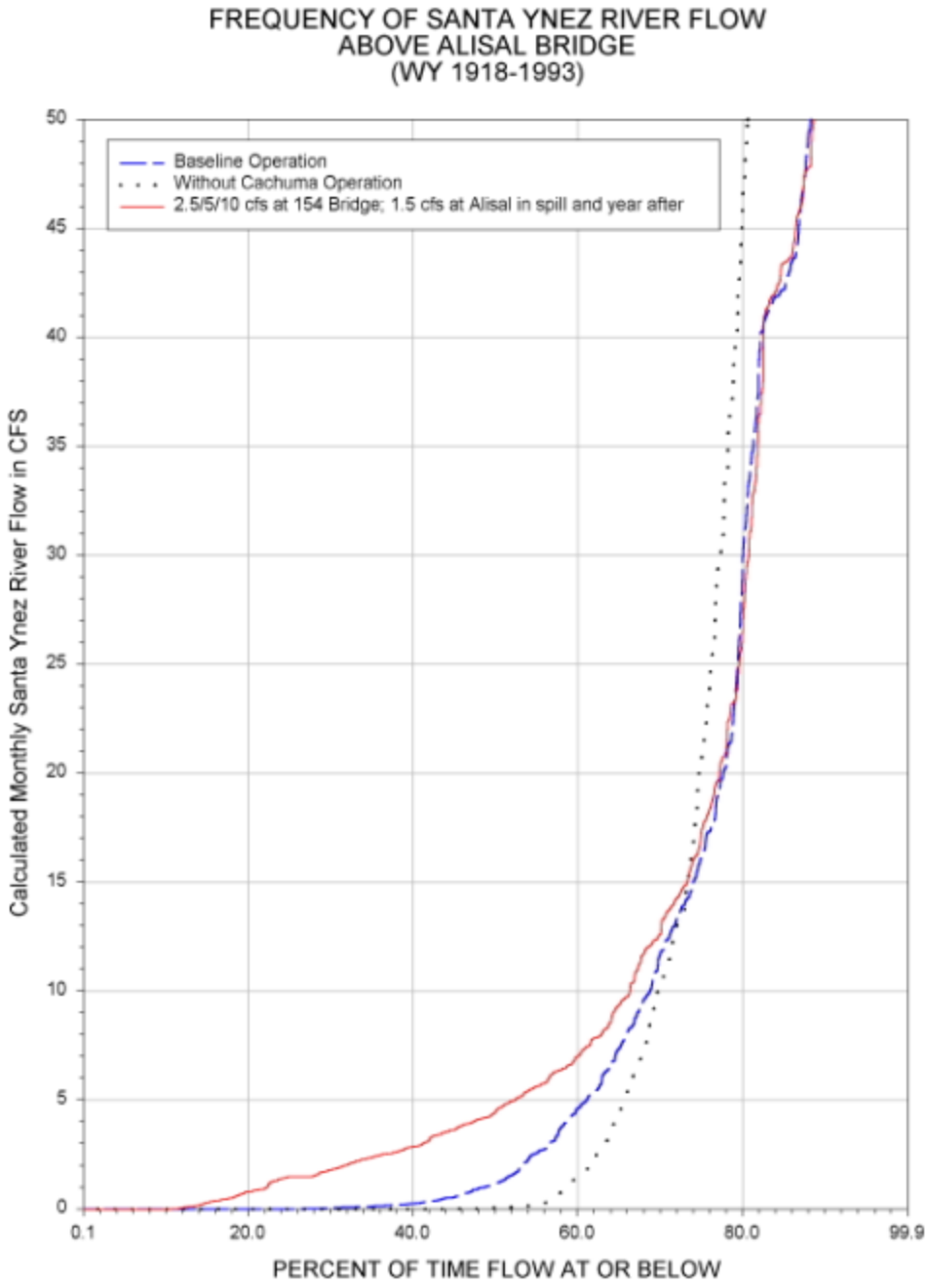

Figure 3-3 Modeled Flow at the Alisal Bridge under Long-Term Operations

3.3.3 FLOW TARGET COMPLIANCE MONITORING

Habitat maintenance flow targets have been established at the Highway 154 Bridge, where there was formerly a U. S. Geological Survey (USGS) gaging station. Currently, a number of options for monitoring the Highway 154 target flow compliance are being explored. The Member Units are in discussion with CalTrans, which has an easement at the Highway 154 Bridge, to allow access for gage installation and monitoring. Until the gage is in place, monitoring of the flow level at the Highway 154 Bridge will occur weekly when flows have receded to the target flow levels using a standard methodology. In addition, a staff gage or other marking devise may be used once weekly monitoring for no less than one rearing season has occurred to establish the relationship between the marker and flow. Flows in the Alisal Reach will likely be monitored by the USGS Solvang gage. Modifications to this gage will be necessary to improve its ability to monitor low flows. If the residual pool depth must be maintained in the interim period in the Refugio and Alisal Reaches, a staff gage installed these pools. The water surface elevation will be monitored weekly.

3.4 PASSAGE FLOW SUPPLEMENTATION

Upstream migration is an important event in the steelhead lifecycle. Steelhead, like the other anadromous salmonids, are born in freshwater and live there for generally one or two years before migrating to the sea. While at sea, they grow to sexual maturity and then return to the stream in which they were born to spawn. If passage from the ocean to their spawning grounds is prevented, steelhead cannot complete their lifecycle and spawn the next generation. When this happens steelhead may spawn in another stream or wait for another year to spawn. Unlike salmon who die after spawning, steelhead are capable of spawning several times (in different years) under the right conditions (Shapovalov and Taft 1954). Prior to steelhead migrating upstream in the river itself, they must first be able to enter the river from the ocean. The mouth of the Santa Ynez River is frequently closed by the presence of a sandbar. This bar forms during the summer when flows are low and wave energy is also low. It is breached in the winter by a combination of higher river flows and greater wave energy. Winter runoff from Salsipuedes Creek appears to be sufficient to breach the bar before enough flow is available in the mainstem. The purpose of the passage flow supplementation is to improve the opportunity for steelhead to migrate from the Santa Ynez lagoon to the mainstem and tributaries upstream of Alisal Road.

The proposed operations provide frequent passage opportunities for migrating steelhead in wet years (spill years). In these years, tributary and mainstem habitat is accessible and of good quality. In dry years, there is a limited number of passage opportunities. Low flows in the tributaries can limit access to tributary habitat, and this habitat is of lower quality in these years. In other years, passage opportunities may be limited while tributary habitats are suitable for occupancy. An experimental program for supplementing existing storm flow has been develop and is described below. The passage flow supplementation plan proposed here promotes good passage conditions in years after steelhead have likely been highly productive in the system. Reclamation and years after steelhead have likely been highly productive in the system.

Reclamation and the Cachuma Member Units will work with NMFS to further refine this program to maximize the positive benefits of the passage releases.

3.4.1 FISH PASSAGE ACCOUNT

For the purpose of supplementing passage flows, a Fish Passage Account will be created in Cachuma Reservoir. The Fish Passage Account will be filled in years when the reservoir surcharges, and released in subsequent years to enhance passage opportunities by augmenting storm flows. The Fish Passage Account will be allocated 3,200 AF of water from the 3-foot surcharge (see Section 3.6 for interim allocations). The Fish Passage Account water will be released starting in the year after the reservoir surcharges to 3 feet, and in subsequent years until there is no more water in the Fish Passage Account.

Fish Passage Account water stored in Lake Cachuma will not diminish by evaporation or seepage losses. Any unused portion of the Fish Passage Account will be carried over to following years until the reservoir surcharges again. In the event of a spill, the Fish Passage Account will be deemed to spill, and the account will be reset to a new allocation of 3,200 AF. If only a partial surcharge is possible (not the complete volume between 1.8 and 3 feet [the first 5,500 AF from the 1.8 foot surcharge supports reservoir releases for rearing target flows]), then the Fish Passage Account would receive the surcharge amount in excess of the 1.8-foot surcharge, plus any carryover in the account with the total not to exceed 3,200 AF. Simulations with the SYRHM indicate that when the reservoir spills, the surcharge space is always completely filled; although, in theory, a partial surcharge is possible.

There is limited data on mainstem fish migration in the Santa Ynez River system and a incomplete record of tributary migration monitoring. The record is incomplete because of difficulty in installing and maintaining mainstem traps and because of the need to remove traps during high flow periods. The SYRTAC migrant trapping program has, however, been able to identify the period when fish are migrating in the system. Specific details, such as the travel time of migrating fish, can not be determined from the existing data. In addition, trapping data is limited to the fairly wet climatic period that the SYRTAC studies have been conducted in. Because some uncertainty regarding the movement patterns of migrating steelhead remains, and because the protocol described below is experiemental, the passage flow supplementation proposal will be adaptively managed. The Adaptive Management Committee (see Section 3.4.3) will be responsible for managing the Fish Passage Account releases. To provide resources for evaluation of the program by the Adaptive Management Committee, the existing tributary migrant trapping program will continue, and an additional trap will be installed in the Refugio Reach to monitor mainstem migrants (see Appendix I for more detail on the monitoring program). The Fish Passage Account releases will be based on the following passage supplementation regime, although modifications may be made based on further biological data, dam operational requirements, fish use, prior hydrologic events, and other relevant factors.

3.4.2 PASSAGE SUPPLEMENTATION CRITERIA

Releases for fish passage supplementation will be made in years following a surcharge year until all of the water in the Fish Passage Account has been released. Releases will be made to augment storms in January through May (passage period). For the purpose of fish passage supplementation, a storm is defined as flows of 25 cfs or more at Solvang (see discussion below). The first storm in January will not be supplemented as it is considered to be a recharge storm and will prime the lower watershed for future releases. All storms in the passage period will be supplemented unless specific conditions are met (see below). No passage flow supplementation will occur until the sandbar has been breached by natural events. The sandbar will be visually inspected each week during the migration season to determine its status, and a water level recorder will be installed in the lagoon to monitor ponding conditions.

For the purpose of fish passage supplementation, a storm is defined as flows of 25 cfs or more occurring at Solvang (monitored at the Alisal USGS gage). The 25 cfs criteria was selected for three reasons. First, 25 cfs provides passage flow in the Alisal Reach, and passage at these critical riffles should indicate that passage is provided over critical riffles upstream to the dam (SYRTAC 1999b). Second, a flow of 25 cfs at Solvang indicates that the tributaries upstream of Solvang (*e.g.*, Quiota and Hilton creeks) are flowing and will provide steelhead access to these habitats. Finally, 92% of the time when there is a flow of 25 cfs or more at the Solvang gage, there is at least 15 cfs flowing in the Santa Ynez River upstream of the confluence with Salsipuedes Creek, indicating there is continuity of flow throughout the mainstem. Passage over the critical riffle at the Lompoc Narrows is achieved 92% of the time that there is 25 cfs at Solvang, indicating passage flows for adult steelhead exist upstream to Bradbury Dam.

The passage flow supplementation will take the form of enhancing the storm hydrograph at Solvang. A decay function for the hydrograph recession at the Los Laureles gage above Cachuma Reservoir has been calculated. Figure 3-4 compares the average storm recession hydrograph for the Los Laureles and Solvang gages. The Solvang gage recedes at a faster rate than the Los Laureles gage primarily because the Solvang gage measures flow from a smaller watershed in the absence of spills at Bradbury Dam. The decay rates begin to diverge at about 150 cfs. The Los Laureles decay function from 150 cfs to 25 cfs takes approximately 14 days. Fourteen days was considered to be a reasonable, continuous passage event for migrating fish. The combination of the divergence, the 14 days of passage flows, and the operational maximum release from the Bradbury Dam outlet works, also 150 cfs, determined the flow trigger for the fish passage releases.

Flow supplementation will begin when the unsupplemented storm hydrograph at Solvang recedes from its peak to 150 cfs. From 150 cfs to 25 cfs, releases will be made from the Fish Passage Account such that the combination of natural flow and passage releases mimic the Los Laureles decay curve at Solvang. From 25 cfs to baseflow, releases will be made based on the mainstem ramping rate (Table 3-4 above). Figure 3-5 shows how basin input and Fish

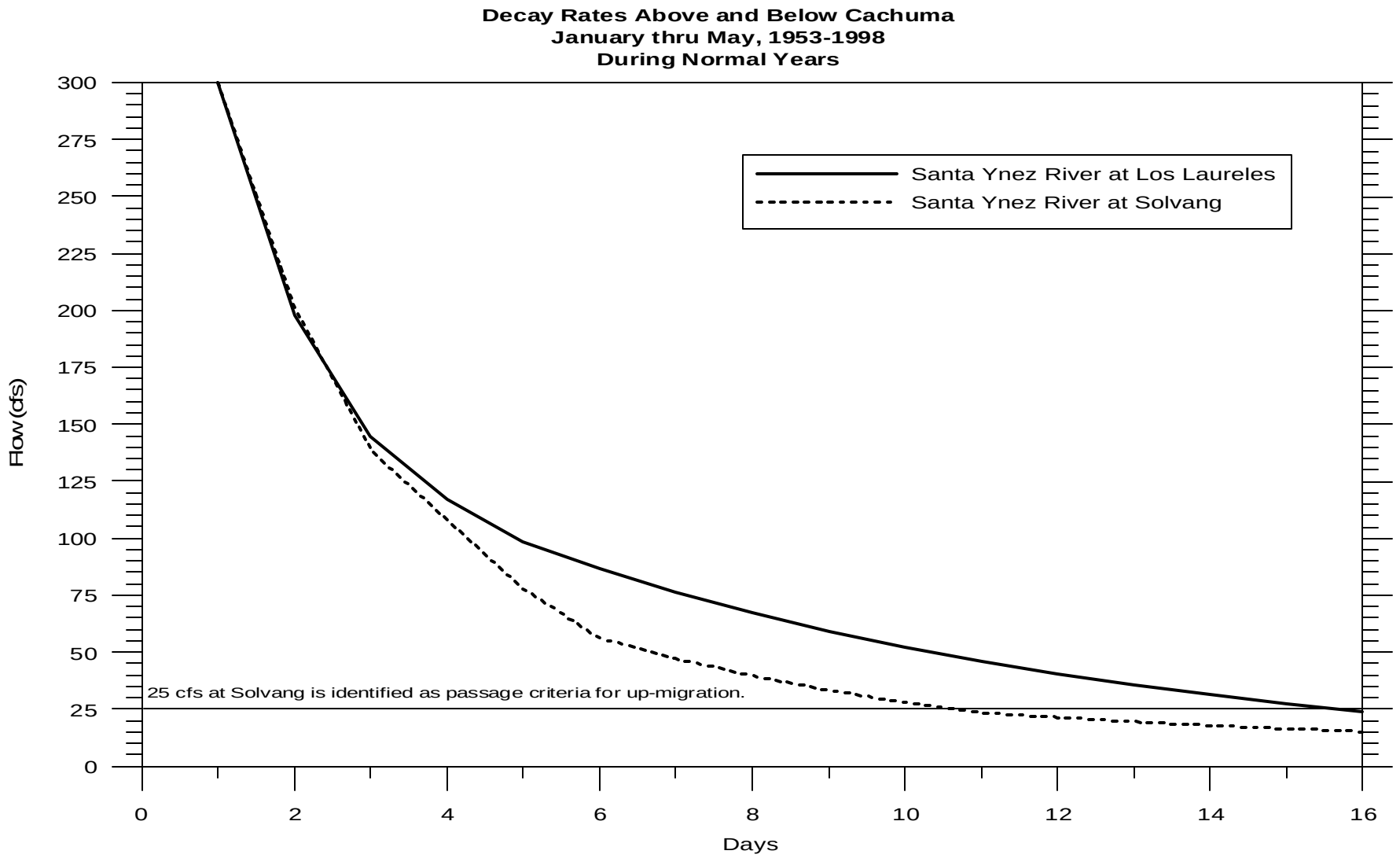

Figure 3-4 Average Inflow Decay Rates at the Los Laureles and Solvang Streamflow Gages

Passage Account releases would combine to provide additional passage days under this flow supplementation scenario (Example #1). In the event that storm peaks at Solvang are less than 150 cfs but greater than 25 cfs, releases will be made from Bradbury Dam to supplement not only the decay curve of the storm hydrograph, but also the peak storm discharge. Thus, up to the outlet works capacity of 150 cfs will be released to boost the peak storm discharge to 150 cfs at Solvang, and then the Los Laureles decay function will be applied as Example #2. Releases for fish passage supplementation will come from the outlet works at Bradbury Dam, although a portion of the releases (≤ 10 cfs) may come through the Hilton Creek supplemental watering system. When several storms come together, there is typically a number of passage opportunities such that supplementing all these storms is not warranted. In the Santa Ynez River watershed, there may be several storm peaks with brief hydrograph recessions in between. When storm flows between these peaks do not recede to 150 cfs, these peaks are all considered to be the same storm event. In this case, passage flow supplementation will occur when flows finally recede to 150 cfs. In other cases, a storm event may trigger the start of the target period for passage releases by reaching 150 cfs, and supplementation will occur such that flows will decay over 14 days to 25 cfs. If a second storm peaks within 7 days following the conclusion of the 14 day target period, the second storm will not be supplemented (Figure 3-6). This criteria establishes a 21 day window in which supplementation of a second storm will not occur. The window begins when the passage flow target period (14 days) is triggered by reaching 150 cfs and continues for 7 days after the end of the target period. If the passage flow target period begins for a storm, but is not completed because a second storm occurs, then the second storm will not be supplemented as it has occurred within a 21-day window. The purpose of this criteria is to conserve Fish Passage Account water for later supplementation, which can extend the biological benefit of the Fish Passage Account into future months and years.

The quantity and frequency of passage releases under the proposal were calculated using USGS gaged daily flows at Solvang for 40 years post-Cachuma construction (1958 to 1998). Flows required to provide passage supplementation for individual storm events are estimated to range from 300 to 1,800 AF. Passage releases would occur starting in the year after the Fish Passage Account is filled by a surcharge event up to, on average, two to three years after the surcharge, but could occur up to eight years after the surcharge event. Table 3-5 tabulates the releases for supplementation of passage by year and shows how the operation of the Fish Passage Account (3,200 AF) would be implemented. In those years when the Fish Passage Account is released in a single year, it is generally because there were a number of small storms whose peaks were boosted and then the recession curve applied.

All storms in the passage period will be supplemented unless (1) flows at Solvang reach 25 cfs within 7 days from a prior fish passage target period (the second storm will not be supplemented), (2) the Adaptive Management Committee determines that there is a greater biological benefit to not supplement a particular storm, or (3) there is no water left in the Fish Passage Account.

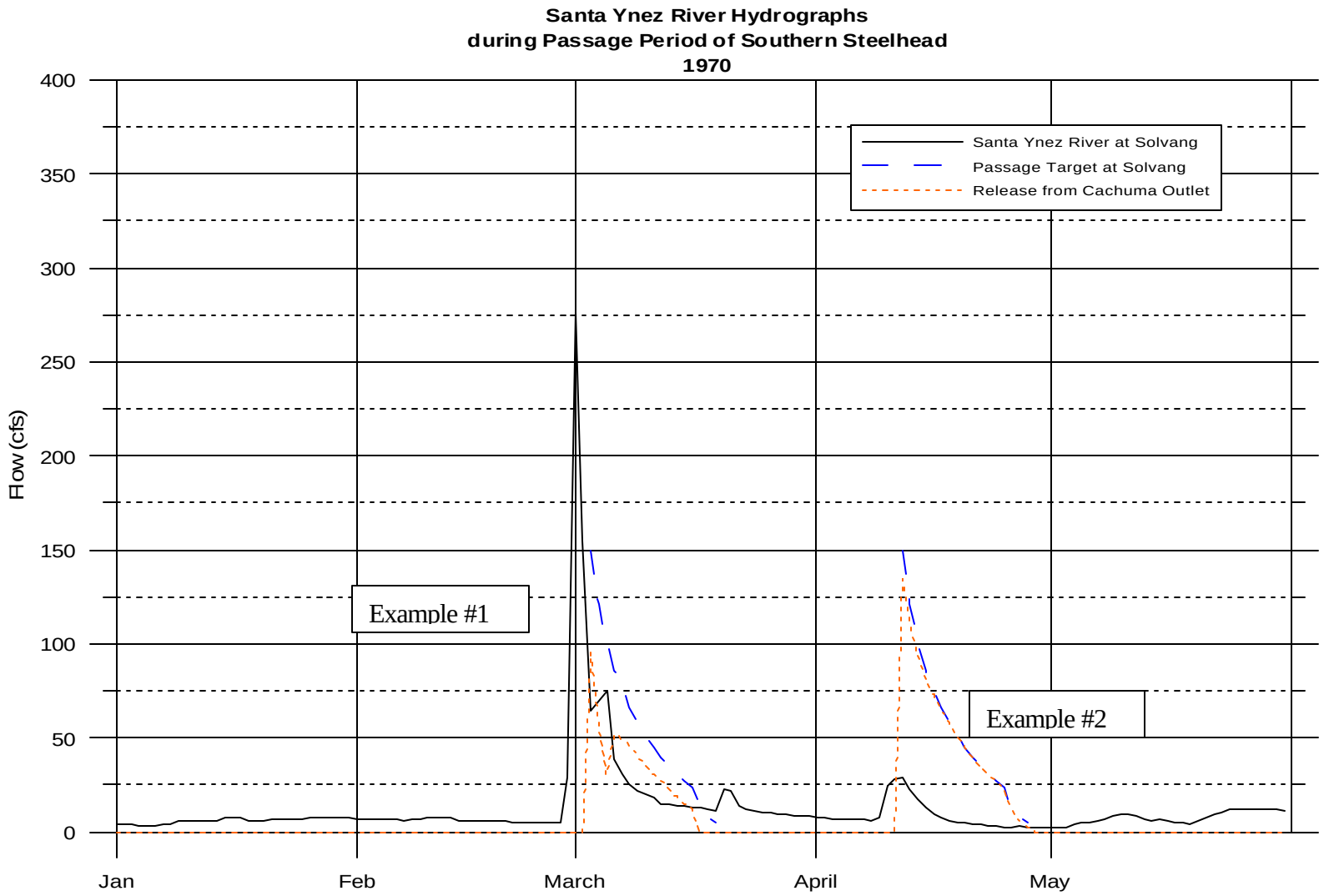

Figure 3-5 Gaged and Calculated Streamflow at the Solvang Gage with Passage Supplementation Releases

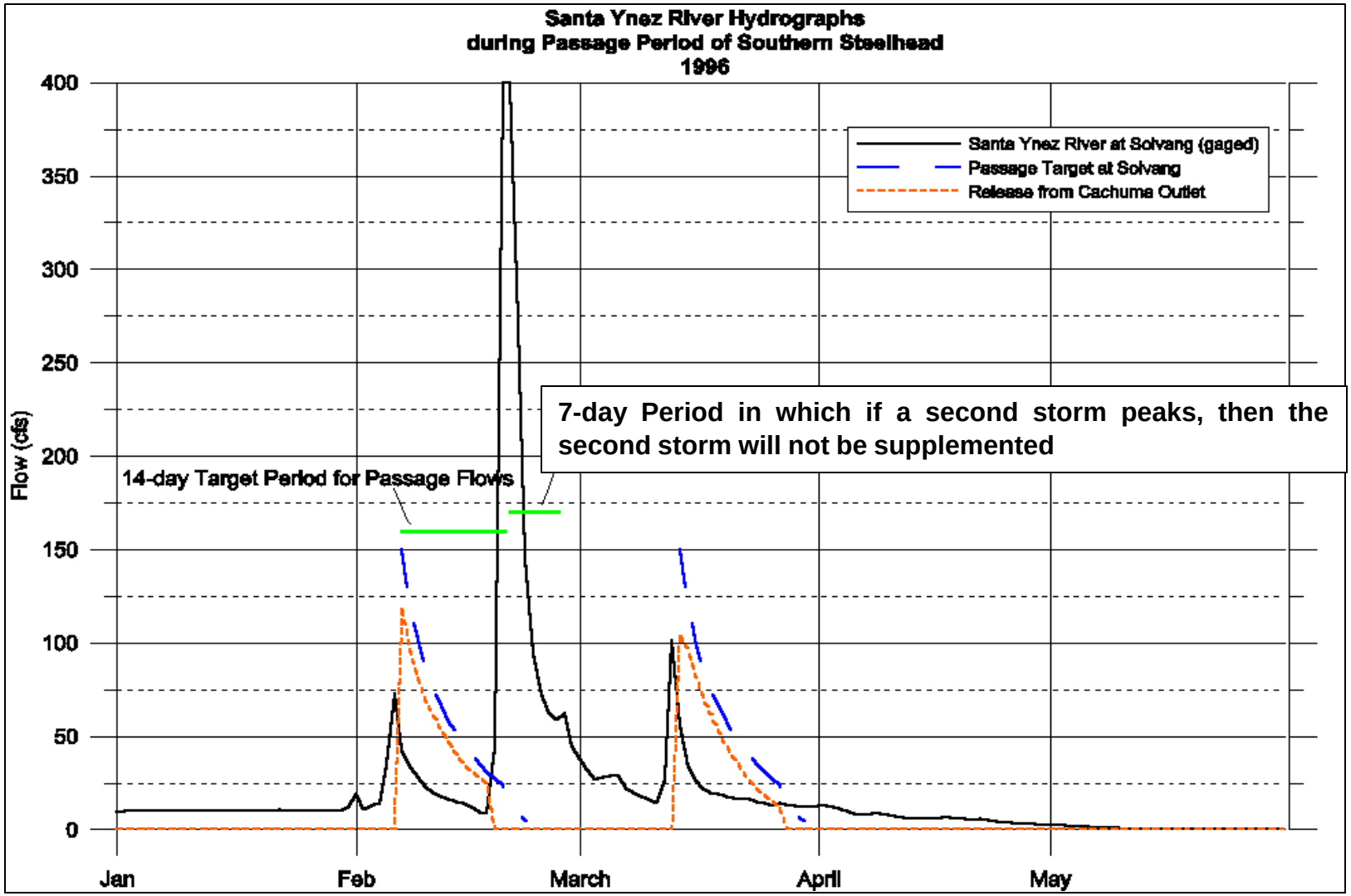

Figure 3-6 Example of the 7-Day Passage Supplementation Criteria

Table 3-5 Long-Term Releases for Passage Supplementation (Water Years, 1958 to 1998)

YEAR	Allocation to Fish Passage Account	Years from Surcharge	Releases from Fish Passage Account	End-of-Year Fish Passage Account Balance
1958	3,200		0	3,200
1959		1	740	2,460
1960		2	2,460	0
1961		3	0	0
1962	3,200		0	3,200
1963		1	3,200	0
1964		2	0	0
1965		3	0	0
1966		4	0	0
1967	3,200		0	3,200
1968		1	3,200	0
1969	3,200		0	3,200
1970		1	2,813	387
1971		2	387	0
1972		3	0	0
1973	3,200		0	3,200
1974	3,200		0	3,200
1975	3,200		909	3,200
1976		1	1,811	1,389
1977		2	0	1,389
1978	3,200		0	3,200
1979	3,200		0	3,200
1980	3,200		0	3,200
1981		1	1,170	2,030
1982		2	1,298	732
1983	3,200		0	3,200
1984	3,200		0	3,200
1985		1	0	3,200
1986		2	957	2,243
1987		3	0	2,243
1988		4	1,670	573
1989		5	0	573
1990		6	0	573
1991		7	573	0
1992		8	0	0
1993	3,200		0	3,200
1994		1	2,759	441
1995	3,200		0	3,200
1996		1	2,716	484
1997		2	484	0
1998	3,200		0	3,200

3.4.3 ADAPTIVE MANAGEMENT OF THE FISH PASSAGE ACCOUNT

The protocol set forth above will be used to supplement passage flows and will be monitored closely to provide information to the Adaptive Management Committee. Operating criteria have to be put in place for monitoring peak storm flows at Solvang and concurrent releases at Bradbury Dam for the purpose of implementing the passage flow supplementation.

Based on the results of these experimental releases, the Adaptive Management Committee will manage the Fish Passage Account releases to increase the biological benefit to steelhead. Initially, all storms will be supplemented as described above. As data are gathered on passage releases, fish movement within the system, and steelhead migration in general, modifications to the release scenario might be made. Such modifications may include changing the trigger flow level, changing the definition of a storm, and selecting to boost storm peaks that are less than 150 cfs to different levels.

Releases in the month of May might also be modified as more downmigrant information is developed. These modifications will likely be similar to those used to extend the water supply availability and might also include extending the tailout for longer periods of time. The decay rate strategy will continue to be applied unless there is data to suggest a more effective release strategy for passage flow supplementation. The Adaptive Management Committee will work with NMFS to refine the fish passage supplementation protocol to (1) shift releases away from dry years and (2) review storm flow decay curves and other methods for providing increased migration ability (NMFS 2000).

Early in the year, water in the Fish Passage Account will be used to supplement every storm meeting the requirements. For releases in late April and in May, however, the committee may begin to consider the storage in Cachuma Reservoir, and the likelihood of a surcharge in the following year, the balance of the Fish Passage Account, the current and prior passage opportunities, and expected baseflow recession levels in deciding whether further supplementation is warranted.

In addition, the Adaptive Management Committee will work with NMFS to develop a strategy to refine this passage supplementation protocol to (1) reduce the number of dry years in which supplementation occurs, to (2) review the use of the mean Los Laureles decay curve as the desired flow shape at Solvang, and (3) to study other methods for providing additional passage opportunities (the strategy must be presented to NMFS by March 11, 2001; NMFS 2000). Once NMFS and the Adaptive Management Committee have agreed to the refinement strategy, it will be implemented.

3.5 ADAPTIVE MANAGEMENT ACCOUNT

The Santa Ynez River system is still under study and new information about many of the operations proposed in this document will be gathered over the course of implementing and monitoring these measures. Many components of the proposed operations will be managed by

the Adaptive Management Committee. This committee will be comprised of a representative from Reclamation, the Cachuma Conservation Release Board, ID #1, the Santa Ynez River Water Conservation District, NMFS and DFG.

Potential scenarios are foreseeable where small amounts of additional water could provide a substantial biological benefit in this adaptive management program. In order to capitalize on these occurrences, an Adaptive Management Account will be established. The Account will contain water that the Adaptive Management Committee can use to provide additional benefits to steelhead and their habitat.

The Adaptive Management Account will be filled in years when the reservoir surcharges to the proposed 3-foot level. Of the additional 9,200 AF provided by the proposed 3-foot surcharge, 5,500 AF supports reservoir releases for the rearing target flows and 3,200 AF is allocated to the Fish Passage Account. The remaining surcharged water (500 AF) will be allocated to the Adaptive Management Account. This account will be maintained using the same guidelines as the Fish Passage Account. The Adaptive Management Account will not experience evaporation or seepage losses; the unused portion will be carried over to the next year; and in the event of a spill, the Adaptive Management Account will be deemed to spill, and the account will receive a new allocation from the surcharged water.

The Adaptive Management Account will be used at the discretion of the Adaptive Management Committee to increase the biological benefit to steelhead and their habitat as opportunities arise. The account water can be used to increase releases for mainstem rearing, provide additional flows to Hilton Creek, or to provide additional water for passage flow supplementation. For instance, perhaps the last storm of the season was the first week in May, and that storm used the remaining water in the Fish Passage Account. However, monitoring data from trapping is demonstrating that a number of smolts are attempting to outmigrate but are having difficulty because of low flows in the mainstem. Water from the Adaptive Management Account could be released to provide additional flow for these fish.

3.6 INTERIM OPERATIONS

Reclamation and the Cachuma Member Units are proposing to surcharge Lake Cachuma and use the surcharged water to provide habitat and fish passage enhancement in the lower Santa Ynez River. Implementation of the surcharge requires environmental review and compliance, and construction of flashboards to enable a surcharge. Because implementation of additional surcharge requires facility modifications, interim operations have been developed to provide increased habitat and passage opportunities until long-term operations are in place (*i.e.*, the 3-foot surcharge water is available).

Interim actions identified to protect and enhance habitat conditions for steelhead within the lower Santa Ynez River have been developed based on results of scientific investigations performed by the SYRTAC in combination with extensive hydrologic modeling to evaluate the feasibility and water supply impacts associated with various alternative interim actions. Field

fisheries investigations have identified factors such as elevated summer water temperature in affecting habitat quality and availability, particularly for summer steelhead rearing. The investigations have also identified the best available habitat for juvenile steelhead rearing at the reach of the lower Santa Ynez River between Bradbury Dam and Highway 154, and within tributaries such as Hilton Creek. The interim plan of action is designed to protect and enhance these high-value habitat areas using resources and modifications to existing operations under the direct authority of Reclamation and the Member Units with support of the Santa Ynez River water users and the SYRTAC.

The proposed interim plan builds on the fishery actions already implemented within the Santa Ynez River to provide the greatest benefits possible to steelhead on a short-term basis within the constraints of reservoir facilities, hydrologic variability within Santa Ynez River watershed, and water supply operations. The fundamental objective of the proposed program of interim actions outlined below, in combination with the fishery actions taken to date, is to protect the Santa Ynez River steelhead. Once the proposed 3-foot surcharge is complete, the additional facilities and operational flexibility provided through the long-term plan will substantially improve instream flow conditions for various life stages of steelhead.

3.6.1 SURCHARGE INTERIM PHASES

Two interim phases of operations will occur prior to implementation of the long-term operations. The first set of interim operations has already been partially implemented, and will be fully implemented on the release of the Biological Opinion and this Plan. The first phase of operations uses the existing surcharge of 0.75 feet. Phase I will continue until the flashboards on the Bradbury Dam radial spillway gates are modified too allow the 1.8 foot surcharge and accommodate the 3 foot surcharge, and there is sufficient rainfall to surcharge the reservoir to the 1.8 foot level. The second phase of interim operations begins when 1.8 feet of surcharge water is available; and it concludes when the proposed 3-foot surcharge is approved, and there has been sufficient rainfall to surcharge the reservoir to the 3-foot level.

Flashboard construction on the Bradbury Dam spillway gates is scheduled for 2001. As stated above, environmental review for implementation of the 1.8 foot surcharge has been completed (Woodward-Clyde Consultants 1995). Implementation of the proposed 3-foot surcharge may require additional actions to be identified through project design and environmental review. It is anticipated that a few years may be required to complete the environmental compliance necessary for implementation of the proposed 3-foot surcharge (environmental compliance anticipated by 2004).

3.6.2 INTERIM MAINSTEM REARING TARGET FLOWS

During interim operations, rearing target flows will be established in the Santa Ynez River for the purpose of improving mainstem rearing habitat. These target flows will be structured to provide year-round rearing in the Highway 154 Reach of the Santa Ynez River. The same rearing target flows will be in effect during both phases of the interim operations (0.75 and 1.8- foot

surcharges). Additional water provided by the 1.8 foot surcharge under Phase 2 of the interim operations (1.8-foot surcharge) will be allocated to passage flow supplementation.

Interim target flows will be established at the Highway 154 Bridge. The flow targets will depend on the water year type and the storage in Lake Cachuma on the first of each month. Reservoir releases through the Hilton Creek supplemental watering system will be made to meet the flow targets. In years when the lake spills (when the storage in Lake Cachuma is above 120,000 AF) and the spill amount exceeds 20,000 AF, a target flow of 5 cfs at the Highway 154 Bridge will be maintained. When the lake does not spill, or the spill amount is less than 20,000 AF, and the storage in Lake Cachuma exceeds 120,000 AF, a target flow of 2.5 cfs will be maintained. When lake storage recedes below 120,000 AF, the target flow at the Highway 154 Bridge will be 1.5 cfs. Periodic releases from Bradbury Dam will be made to improve water quality in the Stilling Basin and the Long Pool in critical drought years (storage in Lake Cachuma <30,000 AF). Thirty AF per month will be reserved to provide these refreshing flows.

In addition, when the reservoir spills at least 20,000 AF or the year following such a spill, the residual pool depth will be maintained in refuge pools in the Refugio and Alisal reaches when steelhead are present. The residual pool depth is defined as the difference between the elevation of the deepest point in the pool and the elevation of the lowest point of the crest (outlet depth) that forms the pool's hydraulic control. Maintenance of the residual pool depth is designed to provide habitat space for the rainbow trout/steelhead inhabiting these habitats and also to improve water quality. There are a number of uncertainties regarding this action, therefore monitoring and evaluation of the action and the maintained habitat will be a focus of the Adaptive Management Committee. Residual pool depth maintenance will be required until the first year the 3 foot surcharge is achieved and all the passage barrier/impediment modifications are completed (NMFS 2000).

Analysis of historical hydrology indicates it will be possible to meet target flows under most conditions. Figure 3-7 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 1.5 cfs about 98% of the time, 2.5 cfs about 81% of the time, and 5 cfs about 49% of the time. Some of this flow persists downstream to the Alisal Bridge in most years (Figure 3-8). The flow can be subsurface and often wells up at the downstream end of some riffle bars.

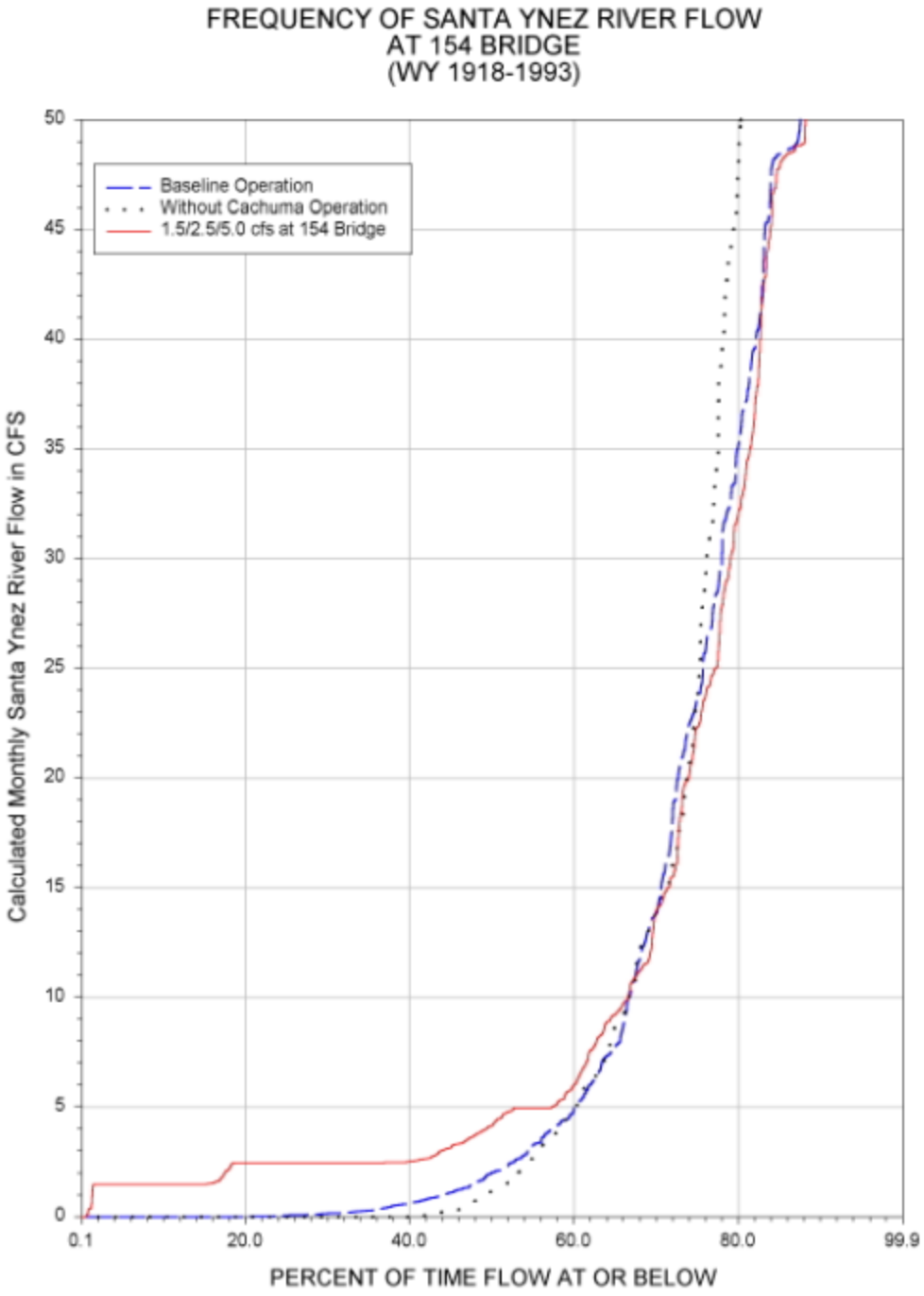

Figure 3-7 Modeled Flow at the Highway 154 Bridge under the Interim Operations

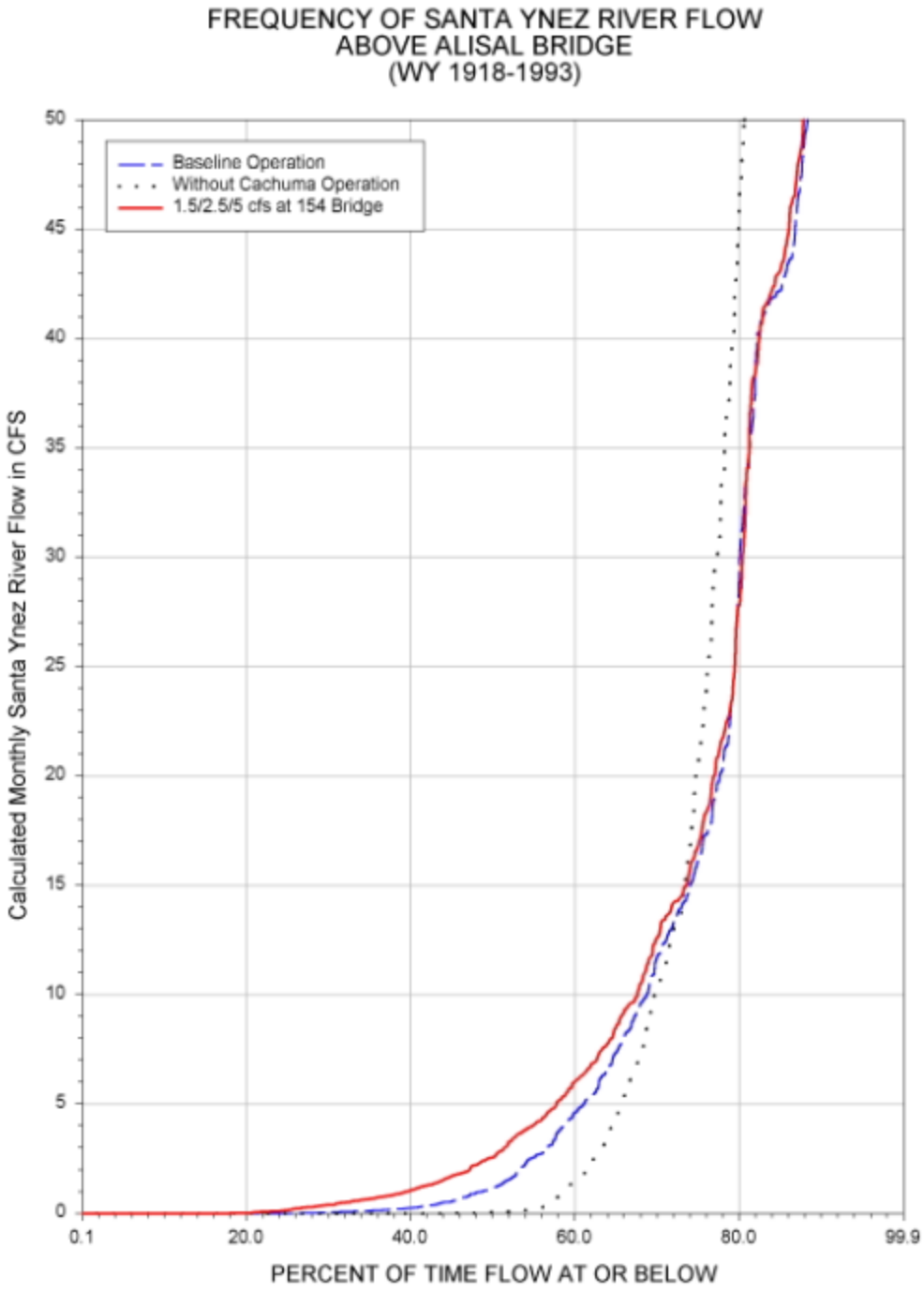

Figure 3-8 Modeled Flow at the Alisal Bridge under the Interim Operations

3.6.3 PASSAGE FLOW SUPPLEMENTATION

Passage flow supplementation will begin under the second phase of the interim operations, once the reservoir has surcharged to 1.8 feet. A portion of the additional water provided by the 1.8 foot surcharge, 2,500 AF, will be allocated to the Fish Passage Account. Water will be released from the Fish Passage Account in years following the 1.8 surcharge event in accordance with the criteria described for long-term operations in Section 3.4.

The quantity and frequency of passage releases under Phase 2 of the interim operations (1.8 feet of surcharge) were calculated using USGS gaged daily streamflows at Solvang for the 40 years of post-Cachuma construction (1958 to 1998). Passage releases under the interim scenario would occur generally one to two years after a year in which the reservoir is surcharged. Table 3-6 tabulates the releases for supplementation of passage by year and shows how releases from the Fish Passage Account would be implemented under this interim proposal. Interim passage releases will be adaptively managed, and the scenario may be adjusted to provide greater benefit to steelhead as described in Section 3.4.3.

3.7 SUMMARY OF FLOW-RELATED FISH ENHANCEMENT OPERATIONS

The long-term operations proposed in Sections 3.3 through 3.5 above will be phased in as additional water resources become available from the surcharge of Lake Cachuma (see Section 3.2). Three different surcharge levels (0.75, 1.8, and 3 foot levels) are proposed over the course of the phase-in period. The interim and long-term flow-related enhancement measures depend on the status of surcharge implementation. Table 3-7 summarizes the three types of flow-related enhancement measures proposed in this document: (1) conjunctive use of reservoir releases and downstream water rights to maintain mainstem rearing target flows, (2) fish passage supplementation, and (3) adaptive management supplementation (rearing or passage). Table 3-8 summarizes the allocation of water provided by the three different surcharge levels proposed for Lake Cachuma to each of these flow-related enhancement measures.

Table 3-6 Interim Releases for Passage Supplementation (Water Years 1958 to 1998)

YEAR	Allocation to Fish Passage Account	Years from Surcharge	Releases from Fish Passage Account	End-of-Year Fish Passage Account Balance
1958	2,500		0	2,500
1959		1	740	1,760
1960		2	1,760	0
1961		3	0	0
1962	2,500		0	2,500
1963		1	2,500	0
1964		2	0	0
1965		3	0	0
1966		4	0	0
1967	2,500		0	2,500
1968		1	2,500	0
1969	2,500		0	2,500
1970		1	2,500	0
1971		2	0	0
1972		3	0	0
1973	2,500		0	2,500
1974	2,500		0	2,500
1975	2,500		909	2,500
1976		1	1,811	689
1977		2	0	689
1978	2,500		0	2,500
1979	2,500		0	2,500
1980	2,500		0	2,500
1981		1	1,170	1,330
1982		2	1,330	0
1983	2,500		0	2,500
1984	2,500		0	2,500
1985		1	0	2,500
1986		2	957	1,543
1987		3	0	1,543
1988		4	1,543	0
1989		5	0	0
1990		6	0	0
1991		7	0	0
1992		8	0	0
1993	2,500		0	2,500
1994		1	2,500	0
1995	2,500		0	2,500
1996		1	2,500	0
1997		2	0	0
1998	2,500		0	2,500

Table 3-7 Summary of Interim and Long-Term Operations for Rearing and Passage Enhancement in the Mainstem

Project Operations Phase	Fish Enhancement Releases for Mainstem Rearing and Passage
Interim Phase I 0.75-Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 5 cfs flow target at Highway 154 in years when the lake spills at least 20,000 AF • 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 20,000 AF • 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed)
Interim Phase II 1.8-Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 5 cfs flow target at Highway 154 in years when the lake spills at least 20,000 AF • 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 20,000 AF • 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed) **Passage** • 2,500 AF allocation to the Fish Passage Account in surcharge years
Long-Term Operations 3-Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 10 cfs flow target at Highway 154 in years when the lake spills at least 20,000 AF • 5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 20,000 AF • 2.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed) *Alisal Bridge Flow Targets* • 1.5 cfs flow target at the Alisal Bridge in years when the lake spills at least 20,000 AF and steelhead are present in the Alisal Reach • 1.5 cfs flow target at the Alisal Bridge in the year immediately following a year when the lake spills at least 20,000 AF and steelhead are present in the Alisal Reach **Passage** • 3,200 AF allocation to the Fish Passage Account in surcharge years **Adaptive Management Account** • 500 AF allocation to the Adaptive Management Account in surcharge years

Table 3-8 Allocation of Surcharged Water under the Proposed Implementation Phases

Surcharge Level	Account/Use	Surcharge Allocation (AF)	Total Amount in Surcharge Years (AF)
0.75 foot (Interim Phase I)	Mainstem Rearing Target Flow Releases*	2,300	2,300
1.8 foot (Interim Phase II)	Mainstem Rearing Target Flow Releases*	3,000	5,500
	Fish Passage Account	2,500	
3.0 foot (Long-Term)	Mainstem Rearing Target Flow Releases*	5,500	9,200
	Fish Passage Account	3,200	
	Adaptive Management Account	500	

*There is no account for the mainstem rearing target flows. The allocation in surcharge years will support the reservoir releases needed to maintain the target flows year-round (except in the driest years), however additional water will be released as needed to meet the targeted flow level. These releases replace the Fish Reserve Account as established in the MOU and WR 94-5.